WORK PLAN

To Discontinue Gas Collection and Thermal Treatment at the:
L&RR Landfill
North Smithfield,
Rhode Island

33 Broad Street | One Weybosset Hill
Floor 7
Providence, Rhode Island 02903

0224263.80
L&RR
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1. INTRODUCTION – OBJECTIVE

The active collection and thermal treatment of gas emissions were a prescribed remedy required by the Record of Decision (ROD) (USEPA, September 29, 1988) for controlling human exposure to the landfill gas emissions at the Landfill & Resource Recovery (L&RR) Superfund Site Landfill, Operable Unit 1 (L&RR Landfill) in North Smithfield, Rhode Island. This remedy underwent startup in 1995 and has been in active operation since that time. However, the ROD also outlined a process for discontinuation of the active system when it could be demonstrated it was no longer needed to prevent significant risk to the public and/or environment.

This Work Plan outlines the proposed process for demonstrating if the gas collection and thermal treatment system can be discontinued at the L&RR Landfill. The purpose of this Work Plan is to gain the concurrence of both the United States Environmental Protection Agency (USEPA) and Rhode Island Department of Environmental Management (RIDEM) on the proposed process prior to the initiation of work.

1.1 Background

Figure 1 shows the L&RR Landfill Gas Collection and Treatment System. The gas collection system consists of 18 interconnected extraction wells distributed across the approximate 25-acre landfill footprint. Vacuum pressure applied to the extraction wells by electric-powered blowers withdraws decomposition gasses from the landfill's waste. This collected gas is thermally treated by combustion within an enclosed flare structure.

The gas collection and treatment system has been operating for more than 20 years, and the generation rate of landfill gas at the Site has continually declined over that time. This decline in gas production is consistent with expectations for a mature landfill. Because of this decline in gas production, the Site is approaching the point where the gas collection and treatment system may no longer be necessary to minimize risk to the public and the environment. This Work Plan outlines the steps needed to determine whether the emission and migration of landfill gas are at a level where the risk is deemed insignificant and the system can be discontinued.

Discontinuing the gas collection and treatment at the Site was anticipated when this aspect of Site remedy was implemented. The gas systems discontinuation is described in the Settlement Agreement and Consent Decree (SACD). The Statement of Work part VI.F specific to the *Discontinuance of Gas Collection and Thermal Treatment System* reads:

> *If, at any time after completion of the first Five-Year Review of the Remedial Action as required by CERCLA Section 121 (c) and any applicable regulations, the Performing Settling Defendants conclude that operation of the gas collection and thermal treatment system can be discontinued and the Performance Standards, including the Rhode Island Air Toxics Standards can continue to be met under open-vent conditions and the remedy is protective of human health and the environment, the Performing Settling Defendants shall submit to EPA a petition, with supporting data, requesting EPA's approval of the discontinuance of the operation of the gas collection and thermal treatment system. Such petition shall also include a Post-Operation Sampling and Analysis Plan (SAP), prepared in accordance with the requirements of Attachment 1, for monitoring compliance with the Cleanup Standards and demonstration of protectiveness after discontinuance of the operation of the gas collection and thermal treatment system.*

In summary, discontinuing the gas collection and treatment requires a demonstration that the uncontrolled release of identified contaminants will achieve Ambient Air Levels (AALs) set in Rhode Island's Air Pollution Control Regulation No. 22 (APCR 22) "Air Toxics" rules. Unstated in the SACD, but equally emphasized by the regulatory agencies, is being able to achieve the soil gas migration standard of Rhode Island's Solid Waste Regulation No. 2, 2.3.08 Gas Control, requiring the concentration of methane gas not exceed 25 percent of the lower explosive limit for methane at the facility property boundary.

This Work Plan outlines a series of steps to determine if emission rates of the identified pollutants are within the APCR22 standards and confirm soil gas migration is controlled. The expectation is to have both the USEPA and RIDEM agree to this Work Plan prior to conducting data collection, modeling, and soil investigation activities described within.

1.2 Applicable Standards

1.2.1 Air Toxics

The SACD established target cleanup levels for specific Contaminants of Potential Concern (COPC) to standards dictated by the Rhode Island APCR22. The AALs listed in the APCR22 are ground-level impact limits that represent the concentrations of substances a facility may contribute to the ambient air at or beyond its property line. Therefore, the compliance point for the target cleanup standards is at the perimeter of the Landfill site.

Furthermore, the SACD identified specific Contaminants of Potential Concern (COPCs) in the landfill's gaseous emissions: chloroform, 1,2-dichloroethane, carbon tetrachloride, benzene, ethylene, chloride, trichloroethene, tetrachloroethene (including 1,1,2,2-tetrachloroethane), and toluene.

The SACD list of the following gaseous emissions of COPC and cleanup levels are.

Table 1-1: Target Cleanup Level and AAL for Contaminants of Potential Concern (COPC)

COPC	Target Cleanup Level ($\mu g/m^3$)*	Current Annual AAL ($\mu g/m^3$)**
Chloroform	0.04	0.2
1,2-dichloroethane	0.04	0.04
Carbon tetrachloride	0.03	0.07
Benzene	0.1	0.1
Methylene chloride	0.2	2
Trichloroethene	0.3	0.5
Tetrachloroethene and 1,1,2,2-Tetrachloroethane	0.05	0.2
Toluene	400	300

Notes:

* In accordance with the ROD, target cleanup levels for gas emissions are equivalent to Rhode Island Air Toxic Regulations (Air Pollution Regulation No. 22), which reflect ambient limits. For the L&RR landfill, the point of compliance is the boundary.

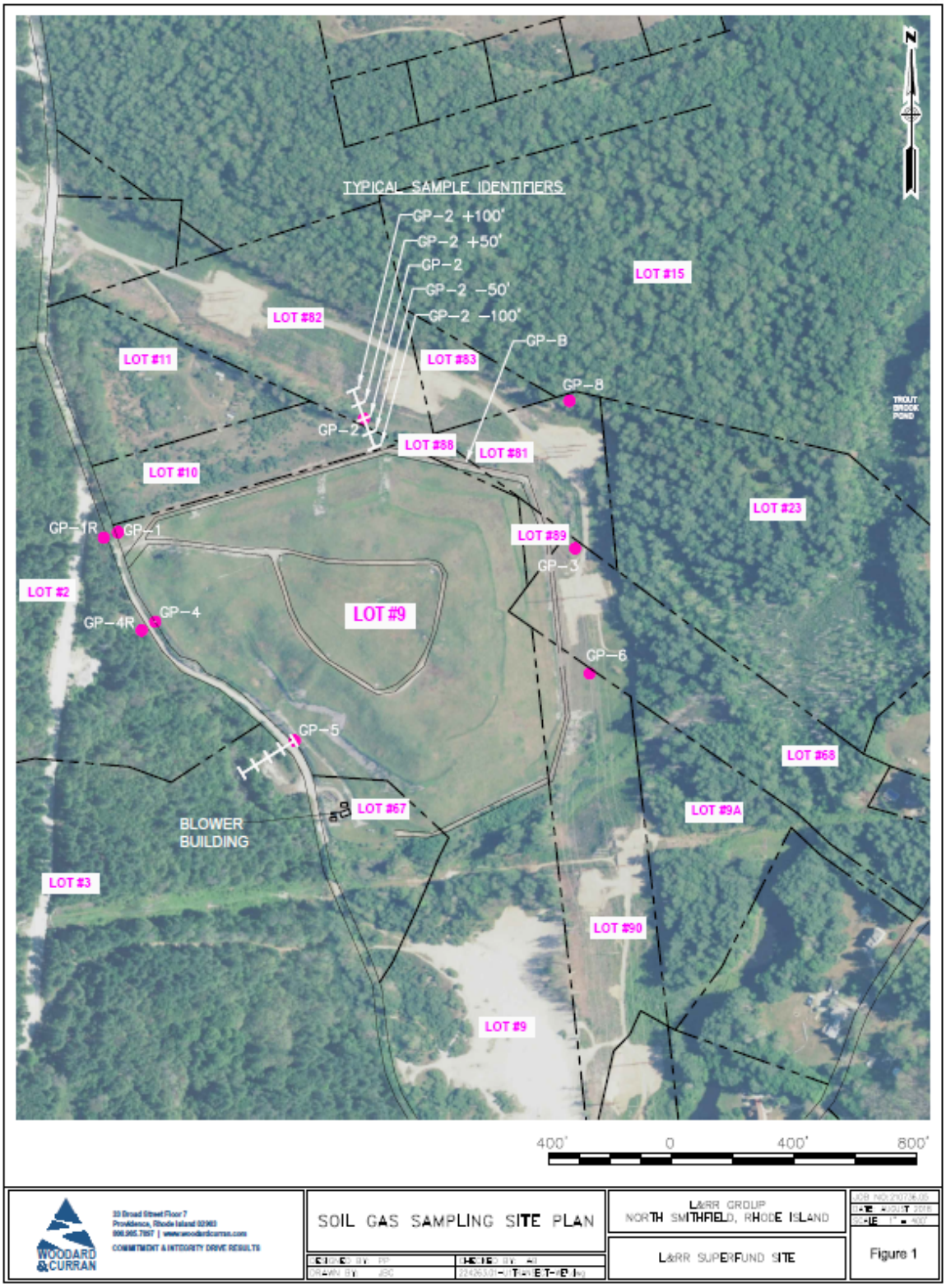
**Acceptable Ambient Level (annual average) from Table I of the RIDEM Air Pollution Control Regulation No. 22 issued in March 1988 and amended in October 2008.

The differences in the target cleanup levels and the current annual AALs on Table 1-1 demonstrate that standards have changed in the past 20-years. For purposes of assessing gaseous emission compliance and discontinuance of gas combustion, the process will apply the current standards of APCR22 for the group of identified COPCs.

1.2.2 Soil Gas Migration

The standard for assessing regulatory compliance for landfill gas in soil is within Rhode Island Solid Waste Regulation Number 2, Solid Waste Landfills, Section 2.3.8(B). Although not in the SACD, the soil gas migration regulations are intended to be protective of adjacent lands. Under the Rhode Island Solid Waste Landfill Regulations, the soil gas performance standard of 1.25% methane by volume, equivalently 25 percent of the lower explosive limit for methane must be met at the facility boundary unless a variance is granted by RIDEM pursuant to Solid Waste Regulations No. 1 – General Requirements part 1.10.

Figure 1: Soil Gas Sampling Site Plan



2. AIR EMISSIONS

The first phase of this evaluation will be to demonstrate that the air emissions from the Landfill will meet AAL standards of APCR22 at the L&RR Landfill property line. The approach described here was applied for similar gas system discontinuance demonstration purposes during the period of October 2007 to June 2008 with the methods accepted by USEPA and RIDEM in Woodard & Curran's Landfill Emissions and Landfill Gas Migration Evaluation Work Plan, dated October 5, 2007.

The method used for the air emissions assessment demonstration will follow a sequence of actions:

1. Characterize the presence and concentrations of uncontrolled COPCs in the gas generated at the landfill.
2. Estimate the landfill's gas emissions rate with the USEPA Landfill Gas Emissions Model (LandGEM).
3. Combine the LandGEM gas emission rate with COPCs concentrations in the gas to obtain the landfill-wide mass emission rates for the COPCs identified in the gas.
4. Utilize the USEPA approved atmospheric dispersion model AERSCREEN to calculate the maximum off-site exposure point concentration based on a unit emission rate for 1-hour, 24-hour, and annual averaging periods.
5. Multiply the COPC emission rates by the maximum calculated exposure point concentration.
6. Compare the scaled AERSCREEN average exposure point concentration for each COPC to the Rhode Island Air Toxics Regulation No. 22 AALs for all averaging periods.

If the modeled COPC concentrations are less than the AALs for the respective COPCs, then the collection and thermal treatment of gas is unnecessary to control air emissions.

2.1 Data Gathering and Gas Characterization

The landfill gas is sampled at the inlet to the flare combustion chamber during routine site monitoring. The typical sample procedure is to use a SUMMA® canister to obtain a gas sample over a 3-hour period then analyze the sample by USEPA Method TO-15 Determination of Volatile Organic Compounds in Air by Gas Chromatography.

We propose to use the recent historical inlet sampling data for the emissions evaluation. The flare inlet is an optimal location to acquire samples. The inlet gas sample is representative of the gas quality for the entire landfill. The inlet gas sample offers a summation of the hours over which it is taken. The active vacuum pressure from blowers overcomes ambient weather effects. Active vacuum pressures applied to the wastes are expected to retrieve greater volatile fraction than might be offered from a passive vent release. A sampling port location specific for this purpose is convenient to access. The inlet is the location from which samples comprise the historic data set.

Gas data for the evaluation of air emissions shall be comprised of gas samples collected from the inlet to flare combustion chamber on these dates:

- April 28, 2017;
- December 8, 2017;
- July 30, 2018; and
- To be determined, later in 2018.

We propose to use only the most recent data because there are trends for decreasing parameter concentrations in the gas as the landfill has aged. We will use the 90th percentile concentration for each COPC identified by Method TO-15

testing. The 90th percentile is consistent with the illustrative case studies found in Section 6 of the Guidance for Evaluating Landfill Gas Emissions from Closed or Abandoned Site (EPA 500/R-05123a, May 2005).

Selection of the COPC for evaluation is guided by the SACD remedial design/remedial action (RD/RA) Statement of Work, part IV.B.3. for operation and maintenance of the gas and thermal destruction system. It states:

> *Calculating the concentrations of each compound detected at the boundary of the Landfill from the enclosed flare and under open-vent conditions after discontinuance of the operation of the flare using an EPA approved dispersion model and comparing the concentrations at the boundary of the Landfill during operation of the enclosed flare to the Rhode Island Air Toxic Standards.*

We propose to limit the evaluation to COPCs detected by test method TO-15. If a particular COPC is not detected in all four of the TO-15 analyses, it will be considered not present at the L&RR Landfill and eliminated from the evaluations. For CPOCs present in one or more samples and not detected in others, we will use one-half of the method detection limits as replacement for the non-detections when calculating the 90th percentile concentrations for those compounds.

2.2 Gas Generation Rate

Woodard & Curran will use the LandGEM Version 3.02 model to predict the emission rates of total gas from the L&RR landfill. LandGEM is an automated estimation tool with a Microsoft Excel interface which estimates emission rates for total landfill gas, methane, carbon dioxide, non-methane organic compounds, and individual air pollutant compounds from solid waste landfills. LandGEM is based on a first-order decomposition rate equation for quantifying emissions from municipal waste landfills.

The LandGEM input requires two important factors to estimate the volume of gas emitted from the landfill, the methane generation rate, k ($year^{-1}$), and potential methane generation capacity, Lo (m^3/Mg). For purposes of the air emissions demonstration the calculations will be performed with the LandGEM default "Inventory Conventional" k-rate of 0.04 for locations receiving more than 25-inches of annual precipitation, and generation capacity factor (Lo) of 100 applicable to most landfills. The selection and recommended use of the two parameters can be referenced to the Emission Factor defaults presented in AP-42, Chapter 2, Solid Waste Disposal (EPA, 1995).

LandGEM gas generation results are also influenced by the mass of waste present and time it was received by the landfill. A necessary model input is waste mass volume expressed in tons. A lack of historical operational records for the L&RR Landfill will necessitate an estimation on how much and when wastes were placed into the landfill. In Woodard & Curran's previous 2008 study the total waste mass was based on a calculated in-place volumetric measure converted to short tons by a factor of 0.837 short tons per cubic yard. This estimated 2,500,000 tons in-place. For modeling purposes, the 2,500,000 tons of waste will assume to be uniformly received and placed in the period of 1969 through 1985. This estimate of waste receipt at the landfill appears reasonable if not conservative for gas generation modeling, as a previous gas generation estimate produced by Canonie, Landfill Gas Treatment Remedial Design Submittal (1993) for the original design of the gas systems, assumed 1,800,000 tons of waste with approximately half of the tons placed in the last two years of landfill operation (EMCON, 1994).

2.3 Dispersion Model AERSCREEN

The Rhode Island Air Dispersion Modeling, Guidelines for Stationary Sources (March 2013 Revision) require AERSCREEN for all screening level air dispersion analyses. Parameters necessary for the AERSCREEN model include emission information, stack dimensions, building orientation, topography, background concentrations, meteorology, and surface characteristics, as applicable. Woodard & Curran anticipates modeling the landfill as a single representative "area" source in AERSCREEN.

Prior to conducting an AERSCREEN analysis, a modeling protocol detailing the analysis plan and presentation of the results will be submitted to and approved by the Rhode Island Office of Air Resources to demonstrate compliance APCR 22 Section 5.1. The developed modeling protocol will include the detailed information requirements checklist found in APCR 22 Appendix B and as summarized:

- Project description with overview, facility plot plan, emissions information and stack parameters.
- Proposed parameters such as land use analysis, local topography, good engineering practice stack height, local anemometer height, and meteorological data.
- Air standards list including all Federal and Rhode Island standards that apply to the project.
- Proposed air quality analysis methods for model, screening, and refined modeling.
- Special considerations like coastal fumigation, health risk assessment, fugitive emissions, deposition, and odor, if necessary.
- Presentation of results to show significant impact areas and compliance demonstrations.

The completed protocol shall be submitted to RIDEM and USEPA for review. We will receive comments from the agencies, respond to the comments, obtain the final approval from RIDEM on the protocol and then perform the modeling. The modeling program concludes with a formal modeling report.

2.4 Calculate COPC Emissions

A prediction of ambient air concentrations at the property boundary for the identified COPCs will be done by multiplying the gas flow rate from LandGEM by the 90th percentile concentrations of the COPCs from the flare inlet gas samples in the following fashion:

Gas flow rate (m^3/year) x COPC concentration ($\mu g/m^3$) / 8,760 (hours/year) = COPC emission rate (μg/hour)

This emission rate for each COPC is then multiplied by the maximum off-site exposure point concentration obtained from AERSCREEN to obtain the predicted concentration of each COPC at the property line compliance boundary for the 1-hour, 24-hour, and annual exposure periods.

2.5 Comparison of Results to Standards

The ROD-specified performance standard for landfill gas emissions is attainment of the Research Institute for Advanced Technology (RIAT) standards at the Site boundary. Demonstration for a successful discontinuation of the gas collection and thermal treatment at the L&RR Landfill shall be made by comparing the predicted COPC concentrations to the APCR22 AALs.

- If all evaluated COPC concentrations are below AALs, then it is appropriate to discontinue the gas collection systems operations. The tops of each gas well may be removed, and the gas allowed to passively release into the atmosphere. We would then proceed with the monitoring outlined in Section 2.6.
- If any evaluated COPC concentrations exceed the AALs, then it is appropriate to continue collection and thermal treatment.

2.6 Ambient Air Monitoring

To verify the results of the air dispersion modeling analysis, air monitoring at the property boundary shall be conducted with the gas collection and treatment system off and the 18 gas wells open to the atmosphere and passively venting. The ROD states:

Such petition shall also include a Post-Operation Sampling and Analysis Plan (SAP), prepared in accordance with the requirements of Attachment 1, for monitoring compliance with the Cleanup Standards and demonstration of protectiveness after discontinuance of the operation of the gas collection and thermal treatment system.

Ambient air monitoring at four locations was originally included in the monitoring program at the L&RR Landfill. The ambient air monitoring program concluded more than 10-years ago upon the data demonstrating the gas systems controls were effective. The flare discontinuation process shall provide similar ambient monitoring to verify the modeling and calculations. One round of air samples shall be obtained at the four locations along the property boundary perimeter using SUMMA® cannisters fitted with a 3-hour regulator and the contents of each air sampled analyzed by Method TO-15. Results of the ambient air samples will be compared with the AAL standards. Demonstration for a successful discontinuation of the gas collection and thermal treatment at L&RR Landfill shall be made, if all identified COPC concentrations are below AALs.

3. SOIL GAS MIGRATION

Rhode Island Solid Waste Regulations establish that the concentration of methane gas cannot exceed 25 percent of the lower explosive limit for methane at the facility property boundary. The Work Plan includes the following investigatory actions to understand the location, distance and frequency of gas migration in soil after the gas collection, and thermal treatment system is discontinued.

3.1 Land Access

The study of gas migration may require sampling of gasses in soil beyond the L&RR Landfill property lines. Access permissions will need to be granted by abutting property owners before off-property exploration monitoring can be conducted. The abutting landowners have not recently been approached to request permission for access to their land. The requests for land access permission will occur shortly after concurrence of this Work Plan is reached with the regulatory agencies.

3.2 Cease Gas Collection

To replicate the circumstances which enhance soil gas migration potential, the assessment of soil gas migration will necessitate that the gas collection be suspended for a period of time to simulate conditions that would occur with permanent flare shutdown. The suspension of gas operations provides a window of time to conduct exploration monitoring for subsurface movement of gas.

Presuming emissions meet the AALs, we propose to shut down the flare for a 90-day period prior to implementation of the gas migration field investigation; the plan is to temporarily shut off the flare for the duration, convert each gas extraction well to a passive vent by removing the well's hose connection to the vacuum pipe, and opening the flow valve on the well.

3.3 Soil Gas Migration Survey

The proposed methods to obtain soil gas migration data generally follow procedures previously used for this same purpose at the L&RR Landfill in 2007 and again in 2009. These are monitoring the compliance gas probes during a temporary shutdown. If measure of methane in one or more compliance gas probes exceeds the standard, then establishing soil gas survey transects perpendicular to the landfill boundary would be established at the probes exceeding the standard. Soil gas measurement extending beyond soil gas probes exceeding standard will be obtained by driving gas Geoprobe® sampling points into the ground at measured intervals along these transects. Figure 1 contains an example of a gas probe transect placed at GP-2.

3.3.1 Data Acquisition

Perimeter landfill gas monitoring at the L&RR Landfill is routinely conducted at permanently established soil gas probes intended for compliance verification, these are named GP-1R, GP- 2, GP-3, GP-4R, GP-5, GP-6 and GP-8. (GP-7 does not exist). Probes GP-1 and GP-4 are also regularly monitored but are on the landfill property and not intended to be for compliance purposes. Each soil gas probe shall be monitored for methane content, carbon dioxide content, oxygen content, total volatile organic compounds, and the data recorded. The soil gas compliance probes will be sampled prior to shutdown of active collection, shortly after shutdown of active collection, and again sampled at three-week intervals during the remainder of the 90-day gas system shutdown. The completed set of measurements consists of five-rounds of soil gas monitoring.

Provided all monitoring verifies the soil gas probes achieve compliance with the standard then survey work is complete.

3.3.2 Establish Transect Locations

Should one or more soil gas probes exceed the standard for soil gas migration then additional monitoring points will be established at the non-compliant probes to determine the extent of soil gas migration beyond the permanent probes.

The planned work activity is to establish transects perpendicular to the property boundary line. The transects will be affiliated with permanent soil gas probes where exceedance of the standard occurred. Temporary gas points shall be installed at 50-foot intervals along the transects. The gas points shall consist of Post Run Tubing (PRT) soil vapor sampling by Geoprobe® installed between 5 and 10-feet below ground surface. When installed, each soil gas probe on the transect shall be monitored for methane content, carbon dioxide content, oxygen content, total volatile organic compounds, and the data recorded. To establish the extent of gas migration the pushing of probes will continue to progress at approximate 50-foot intervals away from the L&RR Landfill boundary until gas is no longer detected in the set probe.

3.4 Compliance Demonstration

Successful demonstration of soil gas migration compliance will be the measurement of methane concentrations at less than 1.25 percent by volume in the gas collection points during the 90-day period.

In the event that soil gas methane concentrations exceed the standards of Solid Waste Landfill Regulations 2.3.8(B) then the alternative route for compliance will be a Solid Waste Variance request pursuant to Solid Waste Regulations No. 1 – General Requirements, part 1.10, and establishment of an Environmental Land Use Restriction (ELUR) for the land areas subject to soil gas migration. An ELUR is an administrative mechanism created to recognize the potential presence of soil gas and establish procedures to address the condition with respect to land use. Examples of an ELUR procedure may be sampling for soil gas during an excavation or directing barriers to gas entry in new building construction.

It is understood RIDEM's overall variance review process may evaluate whether other alternatives are viable to the variance request. The variance request to RIDEM will present that the simple presence of the existing gas collection and thermal treatment system for air emissions control will not be considered a viable alternative as it relates to obtaining a solid waste variance for soil gas at the property line. The original purpose of the gas collection and thermal treatment remedy of the SACD was for air emissions control. Discontinuing the gas collection and thermal treatment is consistent with completion of the emissions control remedy.

4. CONCLUSIONS

It has been more than 23 years since gas collection and thermal destruction controls were initiated at the L&RR Landfill to protect humans and the environment from air toxic emissions. Subsequently, declining gas generation rates which are expected to occur as the L&RR Landfill matures have been observed. This lesser quantity of gas generation combined with generally decreasing concentrations of COPC in the gas appear to create a condition where the gas controls are no longer necessary. It is our opinion that this an appropriate time to commence implementing provisions in the SACD for discontinuing the gas controls.

This Work Plan describes a process to amply demonstrate to both the USEPA and RIDEM that the gas controls at the L&RR Landfill may be removed. The intended outcome of process is to show quantities of gas generated can be safely emitted to the atmosphere without treatment and compliance for any potential soil gas migration will be accomplished through Solid Waste Variance and ELUR.

Satisfying the air emission standard of APCR22 shall be demonstrated by:

- Dispersion modeling which shows that concentrations of COPC detected in the landfill gas are below their respective AALs at the L&RR Landfill property line.
- Verification sampling of COPC in ambient air confirms the AALs are achieved at the L&RR Landfill property line.

Failure to demonstrate the gas collection and thermal treatment can be discontinued at the L&RR Landfill site will result in continuing collection and treatment operations.

Satisfying the soil gas migration standard of Rhode Island's Solid Waste Regulation No. 2, 2.3.08 is accomplished by:

- Soil gas concentrations of methane less than 1.25 percent by volume, equivalently less than 25 percent lower explosive limit or methane at the property line over the course of 90-days.
- If soil gas is identified on adjacent property above the regulation limit, then the Performing Settling Defendants may pursue and establish an ELUR on the subject portions of adjacent property. The process to establish said ELUR will include obtaining a variance from the soil gas migration standard in the Solid Waste Regulation.

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